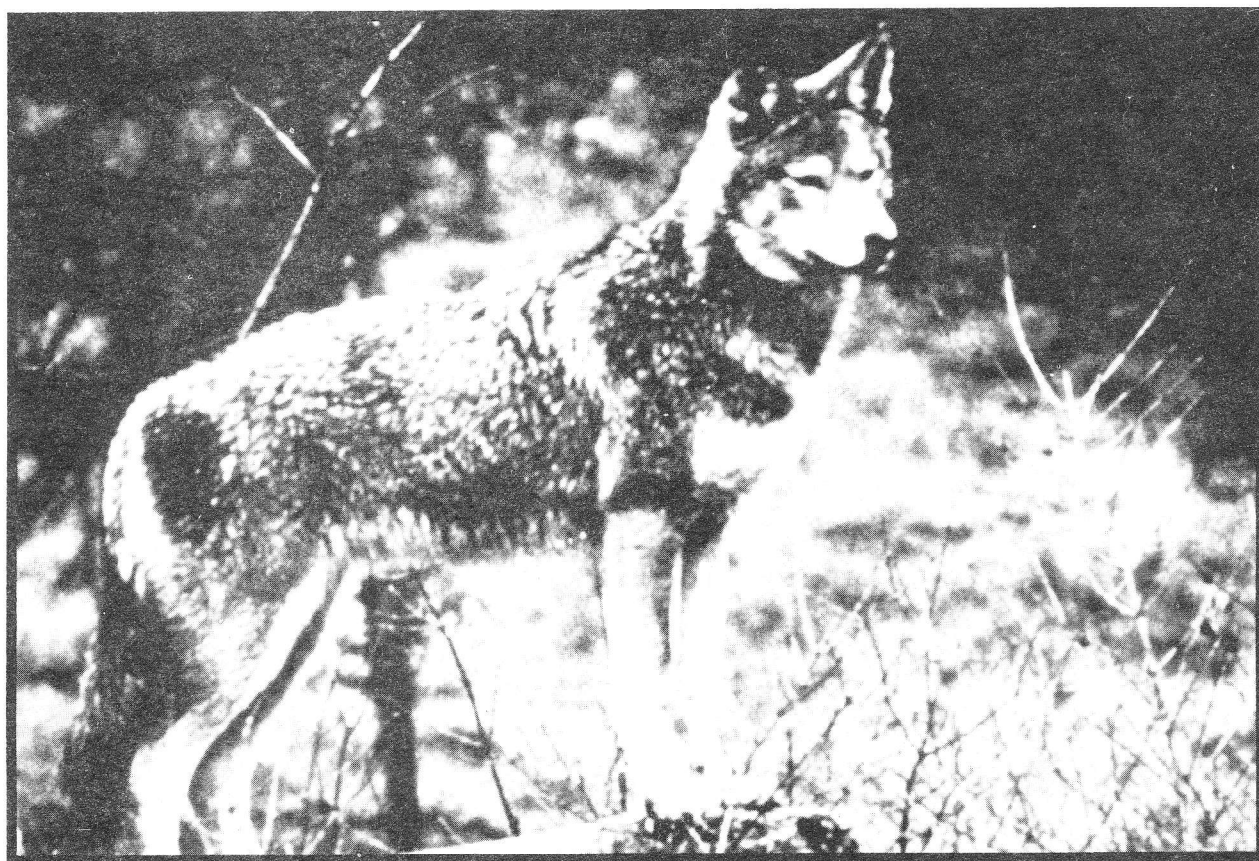


RED WOLF MANAGEMENT SERIES  
TECHNICAL REPORT NO. 7

**A PROPOSAL TO REINTRODUCE  
THE RED WOLF  
INTO THE  
GREAT SMOKY MOUNTAINS  
NATIONAL PARK**



U.S. FISH AND WILDLIFE SERVICE  
SOUTHEAST REGION

A PROPOSAL TO REINTRODUCE THE RED WOLF  
INTO THE  
GREAT SMOKY MOUNTAINS NATIONAL PARK

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A Proposal to Reintroduce the Red Wolf  
into the  
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Introduction

Efforts to reestablish the red wolf (Canis rufus) into portions of its historic range are consistent with Congressional intent as is clearly evident in the Endangered Species Act. Reestablishment of wild populations is also the cornerstone of the Red Wolf Recovery Plan. Only through the reestablishment of a number of wild populations can the red wolf be subjected to natural selective factors and establish a social structure characteristic of the species.

This proposal has been prepared to serve as a planning guide for a reintroduction project in the Great Smoky Mountains National Park in North Carolina and Tennessee. Only 135 red wolves exist at the time of this proposal, most of which are in various captive projects in the United States. In many respects this species is one of the most endangered mammals in North America.

Knowledge of the Species

History

When settlers first arrived in the Southeastern portion of the United States, they encountered large wolf-like animals. These animals, first

described by Bartram (1791) in the eighteenth century, ranged from the Atlantic Seaboard west to central Texas and Oklahoma and northward to the Ohio River valley. Despite man's persecution, these animals were still common in some isolated areas of the Southeast until the early part of the twentieth century. During the first half of this century, however, wolves were extirpated from practically all of their former range. Very few specimens were preserved, and very little was documented about the animal's appearance and life history.

It is believed that this animal, now known as the red wolf, was represented by three subspecies--the eastern (C. r. floridanus), the western (C. r. rufus), and an intermediate form (C. r. gregoryi). The eastern and western subspecies became extinct during the first half of the twentieth century, but C. r. gregoryi persisted in isolated areas from Mississippi to eastern Texas. This last stronghold for the species was slowly compressed over the years until, by the early 1970s, only a few animals could be found in southwest Louisiana and southeast Texas.

The rapid decline of the red wolf in the 1900s is thought to have been caused by increases in human population, changes in land use, and predator control activities. Of special note is the fact that as the red wolf declined, the coyote (C. latrans) moved rapidly into western portions of the wolf's former range. When forced into their last bit of coastal prairie habitat, thousands of years of reproductive separation between the red wolf and the coyote broke down and hybridization between the two species resulted.



Historical information seems to indicate that the red wolf occurred in highest numbers in the great river bottoms of the Southeast. Nowak (1979) also presents information that the red wolf inhabited the higher elevations of the Southern Appalachians. It is thought that the gray wolf (*C. lupus*) also was found in these higher elevations. Our understanding of when and how this happened is poorly documented, but it may have been a sympatric relationship based on glacial advances and retreats.

It was determined that the red wolf could only be saved from sure extinction by a two-pronged effort. The first concentrated on establishing a captive-breeding program, and the second effort was to locate and rescue as many pure red wolves as possible for the captive-breeding project. In November 1973 a red wolf captive-breeding program was established through the Point Defiance Zoological Garden of the Metropolitan Park Board of Tacoma at Tacoma, Washington. In concert with this effort, 40 wild-caught adult red wolves were supplied to the captive-breeding program. The demonstrated reproductive vigor of the species in captivity has allowed the loaning of "surplus" animals to 19 other zoos and captive projects in the United States. All of the original 40 wild red wolves utilized in the captive-breeding program are now dead. Animals presently being utilized in various recovery activities are captive reared. Our experiences to date indicate that these captive animals can readjust to life in the wild, feeding on prey species and reproducing in the wild. By 1987 there were 80 animals in captivity. That year the Service initiated a red wolf reintroduction

project at the Alligator River National Wildlife Refuge in northeastern North Carolina. That project has demonstrated the feasibility of reintroducing captive animals. At the present time there are 135 red wolves in various programs and projects. Approximately 20 are in the wild at four management projects, and the remainder are in captivity. Genetic vigor is carefully maintained by the yearly interchange of animals from one project to another through a scientific strategy developed by the American Association of Zoological Parks and Aquariums. This is documented by a Red Wolf Species Survival Plan and an annual studbook.

The uniqueness of this species is that it was deliberately extirpated from the wild. Only through the reintroduction of the red wolf into secured areas, such as the Alligator River National Wildlife Refuge and Great Smoky Mountains National Park, can the species have any chance of surviving as a truly wild animal. In addition to the Alligator River project, the Service has initiated three island propagation projects, with the sole objective being the production of wild young red wolves. These three projects are located on Bulls Island, a component of the Service's Cape Romain National Wildlife Refuge in South Carolina; St. Vincent National Wildlife Refuge in Florida; and Horn Island, a component of the National Park Service's Gulf Islands National Seashore in Mississippi. Animals taken from these islands have demonstrated their wildness upon being released at the Alligator River National Wildlife Refuge.

## Description

In general, red wolves are intermediate in size between the larger gray wolf, which existed to the north and west, and the smaller coyote of the Western United States. Typically, an adult female will weigh 50 to 60 pounds, while an adult male will weigh 60 to 80 pounds. The red wolf is generally more lanky than the gray wolf, with long, slender legs that some say are an adaption to long-distance running and pursuing prey in river-bottom swamps.

Coloration is apt to be a misleading characteristic for this species. The reddish color referenced in its common and scientific name actually was only typical in certain populations in Texas. There was evidently considerable color variation across its range that also included black, brown, gray, and yellow. The best taxonomical guidance for live animals is general body size, structure, and weight.

The precise place of the red wolf in the evolutionary ladder of the family Canidae will probably always remain uncertain. There is some evidence, however, that supports the thesis that the red wolf actually represents the surviving line of primitive wolves that once ranged over North America a million years ago (Nowak 1972). Various climatic and competitive changes gradually forced the species southward and eastward into the area where they were first encountered by Bartram (1791).

## Life History

In trying to tie together the bits and pieces of factual information regarding the ecology, social structure, and reproductive behavior of this species, it becomes obvious that most information is based on those remnant animals found in Louisiana and Texas, the experimentally reintroduced wolves at the Alligator River National Wildlife Refuge, the island propagation projects, and the captive-breeding program. Very little reliable information is available on the species when it occurred in significant numbers in the wild.

Unlike the gray wolf, the red wolf is not so much a predator on big game animals. Early accounts generally refer to smaller prey animals being the mainstay of their diet. Our most recent investigations with released wolves confirms this through analyses of red wolf scats collected during the projects. Rabbits, raccoons, small rodents, squirrels, muskrats, nutria, fish, insects, and plant materials seem to be preferred. Deer will be taken on an opportunistic basis, and no doubt young domestic animals will also be taken when the opportunity presents itself.

Livestock maintained in fenced pastures would probably not be bothered by red wolves. Such domestic animals, left to fend for themselves in wooded situations, are much more likely to be preyed upon by wolves, especially unattended calves and lambs.

It appears that red wolves travel in family groups, although the actual relationship of wild adult animals to one another is not clear. If they

reflect characteristics of the gray wolf, then mated red wolf pairs will typically stay together as a basic family unit. To date, experience gained from limited red wolf reintroduction attempts supports this conclusion.

Although the last remnant historical population of this species was situated in coastal prairie marshes of Louisiana and Texas, many agree that this environment does not typify preferred red wolf habitat. Heavy vegetative cover does seem to be a needed component of their overall habitat requirements. Historical information, as well as data gained from limited reintroduction work in eastern North Carolina, indicates that the heavy cover provided along streams and in fallow fields constitutes the primary resting and denning areas for the animals.

Like the coyote and gray wolf, red wolves breed only once a year, typically in late February. The gestation period is 60 to 63 days, and pups are born in April or May. While some females are capable of breeding at 9 months of age, it is more common for them to breed in their second season, which occurs when they are about 21 months old. It is thought that male red wolves are not sexually mature before their third breeding season, which occurs when they are about 33 months old. Litter sizes in captivity range from 2 to 8 pups, with an average of 4.6 per litter.

Speculation abounds that red wolves breed freely with coyotes and dogs, with resulting offspring that exhibit innate cunning. In reality, such

occurrences in the wild were probably rare, with resulting offspring that found it difficult to compete with wild wolves or coyotes. These hybrid offspring also exhibit decreased fecundity. Mengel (1971) states that everything points to the decided probability that dog genes do not figure significantly into wild canids in North America. Those red wolves that interbred with coyotes in Louisiana and Texas were individual animals that had lost mates, and with their population at an extreme low, they simply could not locate another red wolf mate. Such hybrids never apparently figured in the population dynamics of either the red wolf or the coyote while the two species' historic ranges coexisted for thousands of years along a line through central Oklahoma and Texas. The abundance of farm dogs in gray wolf range in Minnesota is not known to have resulted in dog/wolf hybridization (Mech, personal communication, 1987).

The home range of the red wolf is undoubtedly dependent upon the quality of the habitat in which it resides. Any discussion of habitat quality is of course based on cover, prey availability, and terrain features.

Telemetry studies of red wolves in Louisiana and Texas indicated that animals often traversed areas larger than required for the purposes of securing food. Shaw (1975) reported an average home range of 17 square miles for two female and five male animals involved in a study of red wolf range in 1972. Riley and McBride (1972), by systematic tracking of three adult animals for over a year, estimated the home range of a red wolf to be 25 to 50 square miles. In a telemetry study in 1974, recovery program biologists concluded that male red wolves ranged over an area of about 45 square miles, while the range of females was somewhat smaller,

averaging 25 to 30 square miles (Carley 1975). Our limited studies of red wolves released at the Service's Alligator River National Wildlife in northeastern North Carolina indicate home ranges of 35 to 50 square miles for adult pairs.

Under wild conditions, red wolves are predominately nocturnal, with highest periods of activity being from dusk to midnight (Carley 1975, Shaw 1975). Another period of activity appears to be from about 3 a.m. until dawn. During winter months, red wolves tend to become more diurnal.

### Requirements of the Species

As is true with any species, the survival requirements of the red wolf are: (1) it must have adequate food, water, and cover; (2) its gene pool must be protected from dilution; and (3) it must be allowed to exist without persecution by man. A discussion of each of these factors follows as they pertain to the red wolf.

#### Adequate Food, Water, and Cover

Historical large- and small-mammal surveys, annual commercial trapper catch and interviews, harvest surveys and hunter interviews, on-site inspections that include track and scat counts, call surveys, and actual trapping of small mammals on designated survey routes are all techniques that yield valuable information as to an area's prey composition and

abundance. Only by expending considerable time on a site can one develop the important "feel" for the actual prey base. Cover requirements can be a more difficult determination. The best available historical information indicates that heavy vegetation is needed by the red wolf. Experiences to date at the Alligator River project, however, also indicate a preference for large agricultural fields. It now appears likely that a combination of cover types and various edge effects provide optimal conditions. Based on known home range requirements, the establishment of a small free-ranging population of red wolves will require an area of at least 250 square miles (160,000 acres). The configuration of the area, drainage and topography, abundance and distribution of prey species, and road development will determine more precisely the maximum number of red wolves that any particular area can maintain.

#### Gene Pool Protection

Since coyote/red wolf interbreeding became a factor in the demise of that last remaining population of wild red wolves in Louisiana and Texas, it is of great importance that this factor be assessed through carefully monitored field studies. Obviously, a coyote-free environment would be ideal for all red wolf reintroduction attempts. If the red wolf is ever to achieve a degree of recovery, however, reintroductions are going to have to be attempted in areas that harbor low to moderate populations of coyotes. Canid experts agree that there is a hierarchy among wild canids. When family integrity is maintained, there is ample evidence



that gray wolves will kill intruding coyotes (Fuller et al. 1981). A critically important need is to determine if red wolves will replace resident coyotes. Regarding feral and hunting dogs, the problem of potential interbreeding is of a much lower magnitude. Our experiences at the Alligator River National Wildlife Refuge indicate that hunting dogs and red wolves avoid each other.

### Coexistence With Man

The degree to which the red wolf can exist in proximity with man is almost entirely dependent on the attitude of the human population within and adjacent to the selected study area. The red wolf is a highly secretive, generally nocturnal animal and was seldom seen under wild conditions. The species recently occurred in an area of Louisiana and Texas with a relatively high human population, and very few conflicts developed. Our experiences with these animals at the Alligator River National Wildlife Refuge project from October 1987 to date, as well as the three island propagation projects, have revealed no human conflicts. Several red wolves have been killed by automobiles on the two highways that bisect the refuge, and several animals have been inadvertently caught in steel leg-hold traps and later released by project personnel. The refuge is open to trapping and hunting, and it is significant that so few interactions have occurred. Deer hunters and trappers have been found to generally be very cooperative and helpful with the red wolf project. Most of man's fears about wolves, especially red wolves, are imagined. There are no recorded incidents of red wolves attacking man;

indeed, the animals in the captive-breeding program are handled (when needed for examination or treatment) with little or no aggressive behavior exhibited by the wolves. Potential reintroduction sites should not be excluded because of the presence of man, unless that presence poses a direct threat to the survival of the wolf. Many landowners in Louisiana and Texas, within the recent range of the red wolf, expressed concern over the fact that the animals would soon be gone from their lands.

#### Great Smoky Mountains National Park

The primary study area is the Great Smoky Mountains National Park, which covers about 800 square miles and straddles the Tennessee and North Carolina border. The park comprises a piece of a relatively contiguous region of forested types, extending from northern Georgia to the Virginia and Kentucky borders. The park is essentially surrounded by national forests except on its northernmost boundary.

The park was extensively logged and farmed prior to the 1930s, at which time park lands were acquired. By 1940 the park had been established and the land had begun reverting to its former forested condition. There is still much virgin timber at the higher and more inaccessible regions of the park, but most of the area now comprising the park was either logged, farmed, or grazed in the past.

Physical Features. The dominant topographic feature of the park is the range of the Great Smoky Mountains with peaks over 1,818 m. The park is surrounded by several national forests, an Indian reservation, a Tennessee Valley Authority lake, and numerous private holdings. Lesser ridges form radiating spurs from the central ridgeline. In broad aspect, the topography of the park consists of moderately sharp crested ridges separated by deep valleys. Many of the mountain ridges branch and subdivide, creating a complex of drainage systems with over 3,057 km of clear mountain streams. The park contains 45 watersheds, and the water table is near the surface in almost all sections. Precambrian metamorphic rocks consisting of gneisses and schists and sedimentary rock of the Precambrian Ocoee series are predominant, while sedimentary rocks in the Appalachian Valley are the youngest. Mean annual temperature for Gatlinburg is 13.7°C, but the average temperature is 5 to 10 degrees cooler at the higher elevations, with warm, humid summers and relatively mild winters. Precipitation averages 1,625 mm annually, but differences in average annual precipitation of more than 600 mm have been recorded between a peak and valley only 15 km apart. Snow accumulations may reach 1.2 m at 1,500 m elevation but are negligible below the 1,000-m elevation.

Vegetation. The deeply dissected landscape present at the southern end of the Appalachian chain provided a refuge for a host of temperate and boreal species during Pleistocene glaciation. This has resulted in a rich vegetative mosaic comprised of approximately 1,500 species of

flowering plants (including 130 trees) and an estimated 2,200 cryptogamous taxa.

Some 30 percent of the park's forests are high in "virgin" attributes. Areas that were farmed or logged have been recovering for varying periods of time and therefore present a wide range of successional stages. Deciduous broad-leaved and evergreen coniferous forests predominate, but treeless grass and heath balds, open wet meadows, and cliff communities occur as well. Vegetation changes continuously with elevation, slope, aspect, and topographic position. Fourteen major forest types are currently recognized within the park. On mesic sites, low and mid-elevation cove hardwood (mixed mesophytic) and hemlock-hardwood forests grade, with increasing elevation, into northern hardwoods and finally, at about 1,500 m, into spruce-fir. On a gradient from mesic to xeric, the cove hardwoods are replaced by mixed oak, xeric oak, and oak-pine. Heath balds represent the xeric extreme at the upper elevations and are dominated by ericaceous shrubs such as Rhododendron catawbiense, R. minus, Kalmia latifolia, and Leiophyllum buxifolium. Perhaps most notable of all the types mentioned are the cove hardwood and the spruce-fir. Cove hardwoods may contain upwards of 20 different species in the canopy at any one site. Dominants often include Liriodendron tulipifera, Halesia carolina, Acer saccharum, Aesculus octandra, and Prunus serotina. Diversity is present in the understory as well. A single tenth-hectare plot may support in excess of 50 species throughout the year. The spruce-fir type occurs only at the highest elevations. This forest contains the largest contiguous block of virgin

Picea rubens remaining on earth. Fully 75 percent of all Southern Appalachian spruce-fir occurs within the boundaries of the park. Additionally, grass balds, ridges, cliffs, and landslide scars within these high elevation forests support the growth of rare regional endemics. Fifteen plants are listed as candidates for Federal protection as threatened or endangered species. Moreover, 120 species are recognized as rare enough to be of managerial concern. A similar number of bryophytes, lichens, and fungi are also considered rare at the regional, national, or global level.

Fauna. Reflecting the richness of the flora, the diverse fauna includes at least 50 native mammals. With the exception of the black bear (Ursus americana) and the white-tailed deer (Odocoileus virginianus), large native mammals are not encountered. However, ranging throughout the park are many medium-sized mammals, including the red fox (Vulpes fulva; sometimes considered as one species, Vulpes vulpes, along with the Old World red fox), gray fox (Urocyon cinereoargenteus), raccoon (Procyon lotor), opossum (Didelphis marsupialis), woodchuck (Marmota monax), and bobcat (Lynx rufus). Several squirrels are seen in the park, including the eastern chipmunk (Tamias striatus), red squirrel (Tamiasciurus hudsonicus), gray squirrel (Sciurus carolinensis), and two types of flying squirrels--the southern (Glaucomys volans) and the northern endangered subspecies (Glaucomys sabrinus coloratus). Other smaller mammals include muskrat (Ondatra zibethicus), cottontail rabbit (Sylvilagus floridanus), and several species of mice, moles, and shrews. Beaver (Castor canadensis), apparently once common before the park designation, are

beginning to reappear in several valleys. Mustelids include the long-tailed weasel (Mustela fenata), mink (M. vison), and skunks. The river otter (Lutra canadensis) has been successfully reintroduced. Several species of bats inhabit the park. The endangered Indiana bat (Myotis sodalis) is known to use at least three of the park's caves as a winter roost. Bison (Bison bison) and wapiti (Cervis elaphus) show little promise of reintroduction because of disease problems and visitor safety. Fisher (Martes pennanti) have occurred in the park and may possibly be reintroduced. Two recent immigrants now occupy the park. Since the 1950s, control efforts have been exercised against the exotic European wild boar (Sus scrofa). More recently, another arrival, the coyote (Canis latrans), has naturally moved into the park. Over 200 species of birds have been observed, including many species of warblers, flycatchers, and other migratory songbirds. Over 60 permanent resident birds, including ruffed grouse (Bonasa umbellus) and wild turkey (Meleagris gallopavo), can be seen year round. The peregrine falcon (Falco peregrinus) was recently reintroduced into the park, with wild birds returning to the hack site area.

The endangered red-cockaded woodpecker (Picoides borealis) has been observed in the western portion of the park. Its present status is unknown. Reptiles include 7 species of turtles, 8 species of lizards, and 23 species of snakes. Heavy precipitation and numerous streams make the mountains in the park ideal for a wide variety of amphibian species. Surveys indicate that the park supports approximately 27 species of salamanders (the red-cheeked salamander [Plethodon jordani] appears to be

a park endemic), 2 toads, and at least 10 species of frogs. Over 40 species of native fish inhabit park streams, including the eastern brook trout (Salvelinus fontinalis; the park's population may be a separate and threatened subspecies). Other threatened and endangered species reported include the smoky madtom (Noturus baileyi), yellowfin madtom (N. flavipinnis), and the spotfin chub (Hybopsis monacha), which are currently being reintroduced into the park. The park also contains a diversity of invertebrates, especially land snails, spiders, insects, and other arthropods that are not well known. Over 100 species each of caddisflies and stoneflies are found within the park, including stonefly endemics such as Megaloptera williamsi, Hansonoperia appalachia, several Capnia species, and Acroneuria lycorias (found only in Sevier County, Tennessee). Over 800 lepidopteran species have been recorded. Most invertebrate groups reveal a complex assortment of forms that often include species endemic to the park and/or new to science.

Wildlife Surveys. From 1987 to 1989 a survey of small mammals in the spruce-fir forests within the park was conducted to assess species presence, distribution, and density. The objective of the survey was to demonstrate the effects of changing habitats on small mammals in a declining forest environment.

Deer: A 2-year investigation of the white-tailed deer population in the Cades Cove area was conducted during the mid-1980s. This study was undertaken to provide insight into the dynamics of epizootic hemorrhagic disease (EHD) and deer movement and density. Park management concerns

were directed at the impacts of this fairly dense deer population on vegetation in the Cades Cove area as well as overall herd welfare. These investigations, and even more recent parasite and disease health checks of the deer herd, indicate the population is healthy.

**Feral Hogs:** For the past 15 years, the National Park Service funded a series of research projects dealing with feral hogs in the park. Research progressed from basic biology and studies of behavior and movement of the species to research concerning the impacts on the native fauna and flora from this destructive exotic. Transects were established to monitor changes in rooting, and several exclosures were constructed to evaluate effects on vegetation over a long period of time. More recent studies have been dedicated to enhancing methods of control of the species by improving the bait used to trap hogs and to developing a population model to predict changes in the total population size that are related to food source, food availability, environmental conditions, and pressure placed on the hog population by management.

**Black Bear:** Over the past 20 years, researchers at the University of Tennessee have monitored black bear populations in the park. Scent station transects have been run for 10 years as a means of assessing changes in the bear population density.



## Reintroduction Philosophy and Strategy

It is generally assumed that reintroduction of a species simply involves the release of animals into a suitable new environment. However, reintroductions are more complicated than assumed in that there are numerous considerations that must be addressed prior to a scientifically developed release. These concerns include subtle balances within the ecosystem, the nature and abilities of the animals, a means of determining the impacts that the reintroduced species may have on the environment, public understanding and acceptance of the objectives of the program, and legal and administrative responsibilities.

The Red Wolf Recovery Plan (Parker et al. 1989) has determined that reestablishment in the wild is the only means by which the red wolf can be preserved as a naturally occurring component of our national heritage. The red wolf, which was biologically extirpated from its last known habitat in southern Louisiana and Texas, is worthy of reintroduction, and the knowledge and techniques required to accomplish such a task have been demonstrated at the Alligator River National Wildlife Refuge project in North Carolina. At the present time the red wolf occurs in the wild only in four carefully managed situations, three of which are island propagation projects. The only mainland project is in northeastern North Carolina on lands administered by the U.S. Fish and Wildlife Service. These properties, now known as the Alligator River National Wildlife Refuge, presently support a wild population of 10 red wolves. Since the original animals were released in September and October 1987, public

acceptance of the project has been gratifyingly positive. The Alligator River refuge project, however, has been conducted on a relatively small acreage of land. The 180,000 acres that comprise this area have to be continually monitored, and on several occasions wolves have strayed off the refuge. When this happened, project personnel were required to recapture the straying animals.

In assessing other potential reintroduction sites within the historic range of the red wolf, priority has been given to Department of the Interior lands. This is thought necessary at this point in the recovery program because of the dedicated usages of Interior properties and the obvious simplification of administrative protocols.

The Great Smoky Mountains National Park possesses many unique characteristics that make it a primary candidate for a red wolf reintroduction attempt. Indeed, there may not be another area within the historic range of the species that has the attributes of the Great Smoky Mountains National Park. The area is of significant size, and there have been numerous biological studies conducted in the park over the past 20 years. Also of special significance is the proximity of National Forest lands around much of the park boundary. In essence, the park is large enough to support a significant number of red wolves, and the potential for agreements with the U.S. Forest Service for an expanding population outside the park is obvious.

At the present time the park supports a prey base that sustains at least moderate populations of black bears, bobcats, foxes, and a recent immigrant, the coyote. The coyote has appeared in the Great Smoky Mountains National Park within the last 10 years.

The literature supports the historical presence of the red wolf in the vicinity of what is now the Great Smoky Mountains National Park. Nowak (1979) lists fossil and archeological finds of both the gray and red wolf around the park. The late Dr. Frederick Barkalow, a noted professor of mammalogy and wildlife management at North Carolina State University, found a red wolf mandible fragment in an Indian midden near Franklin, Macon County, North Carolina (personal communication, 1987). This general area is about 20 miles from the park boundary. The mandible fragment was later identified by Dr. Ron Nowak as a probable red wolf. Of interest is the fossil and archeological record of the gray wolf in the vicinity of the park (Nowak 1979). It appears that both species occurred in the Southern Highlands at various times. Although little factual information exists, glacial activities may have been responsible for the presence or absence of one species or the other. As glaciers advanced southward, the gray wolf may have expanded its range southward. Conversely, as glaciers retreated, the more warmth-adapted red wolf may have moved into more northerly climes, both on a latitudinal as well as altitudinal basis, while the gray wolf migrated northward.

Because of questions regarding coyote and red wolf interbreeding, the park is viewed as an ideal site to test interactions between these two

species of Canis. Information gained from a carefully conceived and executed study would yield valuable insight into the entire range of options regarding red wolf recovery activities.

If it is determined that red wolves replace resident coyotes within the study area, and if it appears that a reintroduction proposal is biologically feasible, then the Fish and Wildlife Service would want to proceed in concert with the National Park Service with a formal reintroduction effort. Experiences gained to date with the Alligator River project, as well as the island propagation projects, have yielded techniques and strategies that have become nearly standardized procedures. Animals selected for reintroduction in the park would be carefully selected from the Service's captive-breeding program and from the wild. At this time it is thought that five pairs of adult proven breeders would be utilized for the reintroduction. Some of the animals could also be selected from the test red wolves utilized in the coyote interaction phase of the project. These animals would be acclimated in 50- x 50-foot pens to break any homing instincts and to get the candidate wolves adjusted to the park environment. Acclimation pens would be sited where the selected family unit would be released.

The requirements of the 1982 amendments to the Endangered Species Act are a major consideration in assessing this proposal. These amendments permit releases of endangered animals under the special designation of "experimental," if such releases are deemed necessary for the continued well being of the species. The "experimental" designation must further

be defined as either "essential" or "nonessential," with a special clause that permits the individual animals selected to be treated as a threatened species. Any red wolves reintroduced into the Great Smoky Mountains National Park would have to be treated as "experimental," but with the full protection of Section 7 of the Endangered Species Act so long as the animals or their offspring remain on the park. Any of the original red wolves or their offspring that leave the park and enter onto private lands would be captured by Fish and Wildlife Service and/or National Park Service personnel and would either be returned to the project or be taken back to the captive-breeding program. Animals that leave the park and enter other Federal properties, such as National Forest lands, would be treated as a species proposed to be listed for purposes of Section 7 of the Act. This means that other Federal land management agencies would have to confer with the Fish and Wildlife Service on their activities that might jeopardize red wolves on their properties, but the results of such conferences would be strictly advisory and nonbinding.

An experimental regulation would be developed to define a host of information for the public regarding a red wolf reintroduction. In this regulation would be an explanation of the "experimental" significance of the proposal as well as an explanation of the "nonessential" designation of those red wolves selected for reintroduction. Regulations concerning Section 9 of the Endangered Species Act would also be spelled out. This particular section of the Act deals with prohibited activities and penalties. In essence, the special regulation can be "tailored" to a

specific area and address special concerns, not only from the local public, but also from Federal agencies that might become involved in the reintroduction proposal.

It is proposed that this particular reintroduction effort be designed with two distinct objectives. The first would address coyote/red wolf interactions under wild circumstances, and the second would be to assess information gained from the interaction study and determine the biological feasibility of reintroducing the red wolf into the park.

#### Project Operational Guidelines and Procedures

In view of the biologically complicated and potentially controversial nature of this proposal, it is essential that clearly understood and mutually agreed upon operational guidelines and procedures be established. These are as follows:

1. The first phase of the proposal, an assessment of the coyote in the park, should be initiated as soon as possible. This will entail the contracting of \$30,000 of Fish and Wildlife Service money through the National Park Service to a qualified researcher. This study should key on determining home range characteristics of the coyote within a definable study area within the park. This objective will also provide invaluable information on such topics as population levels, population dynamics, and the ecological role of the coyote in the park.

2. Beginning with the first phase of the proposal and throughout the actual reintroduction phase, Fish and Wildlife Service and National Park Service personnel will meet with State and Federal agencies, as well as local citizens and civic groups, to disseminate information concerning the proposal.
3. The first phase of the proposal will be initiated during January 1991 with the arrival in the park of several pairs of adult red wolves. These animals will be acclimated for a period of 7 to 8 months prior to the release of one of the pairs and their offspring.
4. Red wolves selected for the study would be formally designated as experimental and nonessential for purposes of the project. These animals would be released into the documented coyote home ranges within the study area. Wolf/coyote interactions would be carefully monitored and assessed for at least a 10- to 12-month period. The Fish and Wildlife Service would provide the necessary funding to cover this aspect of the study.
5. Both Interior agencies would assess biological information gained from the project. A decision to proceed with a formal reintroduction of red wolves into the park would be made by both agencies. If the project is determined to be biologically feasible, a determination to recapture or leave those wolves utilized in the first phase of the project will have to be made. If the project is determined to be biologically infeasible, all red wolves would be recaptured.

6. Based on determinations made in number 5 above, additional pairs of red wolves would be brought to the park for acclimation and eventual release. All releases would be carefully monitored for a number of years. The Fish and Wildlife Service would fund monitoring activities for a period of 2 years after the reintroduction phase is completed.

### Initial Preparations

Public Information. Because the word "wolf" attracts considerable public interest and typically elicits childhood impressions of these animals, it is absolutely imperative that factual information be provided to local citizens. This effort must be done as professionally as possible and must be objective and supported strictly by experience and fact.

A National Park Service and Fish and Wildlife Service information team would be responsible for coordinating information activities. A strategy would be developed that optimizes dissemination of information to the public throughout the initial phases of the project and directs inquiries from the public to the proper authorities. The news media and local outdoor writers would be encouraged to write articles about the project, and local newscasters will be given advance notice of project activities.



## Reestablishment Plan

If, after the first phase of the project, the concept is determined to be biologically feasible, several strategies will have to be initiated simultaneously. These include: (1) administrative efforts to fulfill the conditions of the proposal itself, (2) acceleration of the public information program, and (3) preparation of the reintroduction sites.

Administrative Efforts. The Fish and Wildlife Service and the National Park Service would jointly develop an environmental assessment. The Fish and Wildlife Service would develop an experimental rulemaking package for the relisting of those experimentally designated red wolves selected for the project. A Section 7 consultation will have to be finalized to ensure that the project is not likely to jeopardize the continued existence of the red wolf and that the red wolf will not jeopardize the continued existence of any federally protected species within the park. Federal endangered species permits and State permits will have to be obtained. Funding needs will be supplied by the Fish and Wildlife Service through the reintroduction phase of the project, which will include monitoring for 2 years after the actual reintroduction of wolves. The Fish and Wildlife Service's Red Wolf Coordinator will work closely with Park Service personnel in assuring that approved procedures and strategies are being adhered to during the course of the project. A quarterly progress report will be developed. Maintenance of red wolves during acclimation, as well as the radio tracking of released animals, could probably be done by contract to a qualified University. To address

daily field and office activities during the acclimation period, and especially during the release phase, the Fish and Wildlife Service will assign an experienced red wolf biologist to the park. This individual will be responsible not only for the technical aspects of the project but also the many unscheduled activities that are unavoidable in a project of this scope.

Public Information Program. The period of time from project approval to actually bringing mated pairs of wolves to the park for acclimation and eventual release will attract a great deal of interest by the news media, much of which will be national and regional in scope. Similar interest can be expected after releases are made, with a gradual tapering off after the initial 6 months.

Preparation of Reintroduction Site. Acclimation pens will have to be constructed at various sites within the park prior to receipt of the first pairs of wolves. Project personnel must be trained in the care and handling of these animals during the 6-month acclimation period. In addition, a radio-tracking system will be implemented; personnel will be trained in its utilization from mobile and fixed-ground stations, as well as when tracking from aircraft.

Release Strategy. The spring months are considered as the best time for a release. It will have given the wolves 5 to 6 months to adjust to their new environment and will have broken any homing instincts the animals may have retained. This period of the year is also the time when

more young and less wary prey specimens are available. This in turn provides the wolves greater opportunity to gain experience in the capture of prey and improve hunting techniques as prey become less available and more wary.

Recapture Techniques and Procedures. Equipment and procedures for recapturing released red wolves will be available throughout the project. Recapture techniques include modified leg-hold traps, walk-in live traps, tranquilizing darts, and radio-activated recapture collars.

Our experiences to date at the Alligator River National Wildlife Refuge and with the island propagation projects is that red wolves are relatively easy to capture using leg-hold traps. Every attempt to capture a wolf has proven successful, generally with very little stress to the animal. Trapping radio-marked red wolves requires the expertise of a qualified trapper and the proper equipment. Each trap is set rigged to a transmitter beacon, and upon being sprung, project personnel can be at the trap site in a matter of minutes. In addition, each trap is typically fitted with tranquilizer tabs so that the animal ingests a small amount of drug in biting at the trap. Usually, project personnel find a drowsy wolf with little struggling evident.

A recapture collar (Mech et al. 1984) recently developed by 3-M Corporation and now being marketed by Wildlink, Incorporated, would be utilized during the first phase of the proposal. This unique system of data acquisition and recapture includes an integrated microcomputer-

controlled radio transmitter/receiver collar with two 1.5 mL darts, a mercury tilt switch activity sensor, and a device for releasing the collar off the animal. A computerized triggering transmitter is used to communicate with and control the collar functions. The use of this collar will significantly enhance the capability of the project to not only gather biological data but to also ensure quick retrieval of an errant red wolf.

### Effects of Wolf Reestablishment

The successful reestablishment of a population of a critically endangered species such as the red wolf would attract significant national attention to the Great Smoky Mountains National Park. This attention would likely draw a number of people to the park who would otherwise seek other areas for a wilderness experience. These thoughts are based in part on reports from Algonquin Provincial Park, Ontario, Canada, where the park's gray wolf population attracts thousands of people each year who come expressly to hear wolves howling (Kolenosky et al. 1978). A successful reintroduction, however, would have greater merit than just public appeal. Such a success would be a major move in recovering a species that for all practical purposes is nearly extinct. It would especially underscore the capability of Federal and State conservation agencies to work cooperatively under very difficult circumstances for the common good of a unique animal that has been absent from the mountains of the Southern Appalachians for nearly a century.

From a strictly investigative perspective, the project would prove invaluable in answering a pivotal question regarding the recovery of the red wolf. The relationship of this endangered species and the coyote has to be resolved.

Precisely how the red wolf will impact the coyote in the park is unknown. It is hoped that the wolf will prove capable of replacing the coyote in a naturally occurring ecosystem, and thus reestablish a top predator in the park.

On the other side of the coin, there will always exist the possibility of a red wolf getting off the park and killing some chickens or other livestock. There are private conservation organizations willing to financially underwrite any such private livestock losses. Animals that leave the project area will come under special provisions of the experimental regulation. Such provisions will likely require the early notification of project personnel so that errant wolves can be recaptured. Realistically, this is not expected to be a problem.

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